KOLKATA

THE WATER-WASTE PORTRAIT

Neglect has led to disrepair and breakdown of water distribution and wastewater exit. Skewed policies have led to encroachment of the natural waste treatment engines, the wetlands. Groundwater is dipping – Kolkata has much to contend with in the coming years

Source: Anon 2011, *71-City Water-Excreta Survey, 2005-06*, Centre for Science and Environment, New Delhi

WEST BENGAL

Kolkata

Some 315 years ago, British merchants had dropped anchor at the small hamlet of 'Kolikata' on the eastern corner of the Indian sub-continent. Soon after, they were granted trading rights and the area saw spectacular growth – the merger of the three hamlets of Kolikata, Sutanuti and Govindpur led to the creation of a hub for British commercial and business interests and activities in the sub-continent: the city of Calcutta. Regarded today as one of the biggest cities in the world, it is also the fourth largest in India in terms of population. It was later renamed Kolkata.

Over the years, Kolkata has grown sporadically and haphazardly, not conforming to any master plan. The main city forms the nucleus of the Kolkata Metropolitan Area (KMA), which comprises of three municipal corporations – the Kolkata Municipal Corporation (KMC), the Howrah Municipal Corporation and the Chandan Nagar Municipal Corporation – 38 municipalities and 33 village councils in all. The Kolkata municipality covers only 11 per cent of the KMA's area: it is spread over 187 sq km, consists of 15 boroughs or administrative blocks and 141 wards, and stretches for more than 96 km along the Hooghly river, which skirts the western flanks of the city.[1]

This river is the primary source of surface water for the city. Kolkata is a city endowed with substantial water resources. It has another river to its east – the Kulti Gong, 28 km away – where the city can drain its wastewater. It has good groundwater reserves too. It also has a huge wetland to its east for its wastewater to flow through before it hits the river and then the Bay of Bengal. This massive biological cleaning system is also highly productive – it grows food and spawns fish, which is then supplied to the city. Waste to wealth.

But now, this system is falling apart. Kolkata has been rather tardy in upgrading its antiquated water and sewerage system. This, even as the city has the advantage of water which many do not, says city-based ecologist Dhrubajyoti Ghosh.[2] This is partly because the city systems have failed to keep up with the growing population. As per the Census of 2001, the population in the metropolitan area had jumped from less than 8 million in 1971 to nearly 15 million in 2001. Density of population has risen from 3,817 persons per sq km in 1961 to 7,950 in 2001.[3] Compared to this surge in numbers, service coverage is, at best, inadequate: about 80 per cent of the population has access to official water supply, officially only 50 per cent can avail of sewerage services.

But this breakdown is also because of deliberate policy and wilful neglect. The city is destroying the very ecological endowment which gave it its water-waste wealth. Kolkata's groundwater is now increasingly over-exploited and polluted; its wetlands are now being filled up for urban growth. The city has to find answers and find them fast.

THE CITY	
Municipal area (Kolkata Municipal Corporation)	187 sq km
Total area (Kolkata Metropolitan Area)	1,750 sq km
Population (2005) of KMC	5.4 million
Population (2011) of KMC, as projected in 2005-06	6.2 million
THE WATER	
Demand	
Total water demand as per city agency	925 MLD
Per capita water demand as per city agency	170 LPCD
Total water demand as per CPHEEO @ 175 LPCD	952 MLD
Sources and supply	
Water sources	Hooghly river, groundwater
Water sourced from surface sources	89%
Water sourced from groundwater	11%
Total water supplied	1,216 MLD
Per capita supply	224 LPCD
Leakage loss	35%
Actual supply (after deducting leakage losses)	790 MLD
Per capita supply (after leakage losses)	145 LPCD
Population served by water supply system	85%
Per capita supply in the served area	171 LPCD
Demand-supply gap (after leakage losses)	135 MLD
Treatment	
Number of WTPs	3
Total treatment capacity	1,580 MLD
Actual treatment	1,080 MLD
Future demand and supply	
Demand (2011), as projected in 2005-06	1,049 MLD
Augmentation needed to meet the demand	Nil
Required increase in supply	Nil
THE SEWAGE	
Generation	
Total sewage generated as per city agency	1,112 MLD
Total sewage generated as per CPCB	734 MLD
Collection	
Length of sewerage network	1,610 km*
Population covered by sewerage network	50%
Area covered by sewerage network	55%
Treatment	
Number of STPs	4
Total treatment capacity	173 MLD
Actual sewage treated	173 MLD
Disposal	East Kolkata Wetlands and the Hooghly

Source: Anon 2011, *71-City Water-Excreta Survey, 2005-06*, Centre for Science and Environment, New Delhi
Note: *Of which 1,430 km has piped sewers, while brick sewers line 180 km

R K SRINIVASAN / CSE

A tug-of-war goes on between real estate and Kolkata's natural wastewater management mechanism, the East Kolkata Wetlands

WATER

DEMAND AND SUPPLY

In Kolkata, two agencies jointly run the water management system: the Kolkata Municipal Water and Sanitation Agency (KMW&SA) and the municipal corporation or KMC.[4] The KMC is in charge of the Kolkata municipal area, while the KMW&SA covers the rest of the metropolitan area. Within its jurisdiction, the corporation is responsible for virtually all civic services – supply of drinking water, sewerage and drainage, solid waste management, maintenance of roads, street lighting and slum development works. The agency, on its part, takes care of maintenance, development and regulation of water supply, sewerage and drainage services and collection and disposal of garbage in the metropolitan area.[5]

Estimations of the city's water demand at the time of the CSE survey in 2005-06 varied between agencies (see Table: *The water*), but the city authorities maintained that irrespective of differences, about 1,216 million litre a day (MLD) was being supplied – much more than what the city needed. Of this, surface water sources like the Hooghly provided 1,080 MLD, while 135 MLD of groundwater was sourced from 340 borewells and 7,825 small diameter tubewells run by the KMC.[6]

As per estimates at the time of the survey, by 2011, the city was expected to face an almost 14 per cent rise in its water demand. While its official supply figure indicates that Kolkata would be able to meet the hike comfortably, the situation on the ground proves otherwise.[7]

This is because the city has been 'losing' about 35 per cent of the water it sources. As a result, from being a water-surplus city supplying over 224 litre per capita per day (LPCD), it has gone on to become a water-short city supplying 145 LPCD.[8] And even this, given the shoddy state of its distribution pipes, is possibly an overestimate. Large areas of the city remain dependent on groundwater, which has been declining precipitously in this otherwise water-flush region.

SOURCES AND TREATMENT

The first potable water supply system in the city began operations as early as 1869, when a 27-MLD slow sand filter plant was installed at Palta some 30 km away, with a pumping station at Tallah (see Map: *The water-waste portrait*) on the Hooghly. The plant brought filtered water to a population of 0.4 million.[9] Over the years, the plant has been augmented (renamed the Indira Gandhi Water Treatment Plant) to supply 1,170 MLD.[10] In addition, the city has two more water treatment plants (WTPs), while another two are coming up. The two existing plants are at Watgunge and Jorabagan; the ones being built include the Dhapa plant and one at Garden Reach.[11]

Supply of water to the newly developed north-eastern fringes of the city, including the reclaimed township of Salt Lake, involves a 42-km trunk main and four stages of water pumped out from the Hooghly. The consumer pays dearly: over Rs 13 per kilolitre (kl).[12]

In 2006, the 135-MLD WTP was planned at Dhapa under the

Jawaharlal Nehru National Urban Renewal Mission (JNNURM) to cater to the needs of these newly developing areas along the EM by-pass and Rajarhat.[13]

At the existing plants, water is treated through a tertiary treatment process. The quality of the water leaving the plants and pumping stations is potable, but it gets polluted on its long journey to the consumer. Contamination by faecal bacteria is of serious concern. In many areas, hardness and high iron content of the water are pressing problems. A 1997 water quality survey of the Ganga by the Nagpur-based National Environmental Engineering Research Institute (NEERI), conducted on behalf of the metropolitan authority, indicated a high degree of contamination from wastes of domestic and animal origins.[14]

GROUNDWATER

Kolkata has rich reserves of groundwater, available at a depth as little as 3 metre (m) from the surface.[15] It is accepted by the government that piped water does not reach most parts of the metropolitan region, and groundwater remains the only source for the people in these towns and villages.[16]

This groundwater is sourced by government agencies to maintain supply to the city. Kolkata's groundwater occurs in the confined aquifer system, with a clay layer overtopping the two distinct water-bearing sediments. The first aquifer lies at a depth of 21-25 m and the second at 41-46 m. At the time of the survey, all 340 borewells in the city were tapping water from this second layer, which contained good quality water. These wells yielded, on an average, 90,000 litre per hour, running for about eight hours daily. Kolkata also has some 6,000 small diameter tubewells yielding about 9 MLD. Groundwater supply from all these sources adds up to 136 MLD.[17]

But if water-wealth is not cared for, it will not last. This is what is happening to the groundwater in and around Kolkata. A large number of tubewells sunk by private industries and business establishments, housing estates, high-rise apartment blocks and households, have been extracting without paying any attention to recharge. According to estimates by KMC officials in June 2006, there were as many as 6,000 private tubewells within the municipal corporation area. In addition, private tankers were also sourcing the same groundwater, and supplying to establishments in and around the city. No estimation of their numbers were available.[18] According to estimates, in the five-year period from 1998 to 2003, the groundwater extraction rate doubled. As this can ultimately lead to gradual subsidence of land in the deltaic zone, a licence from the government has now been made mandatory to sink deep tubewells.[19]

However, this reckless and unplanned withdrawal has led to a noticeable drop in groundwater levels. This extraction has been leading to the development of a 6-8 m conical depression in central and south-central Kolkata. This trough has reversed the natural direction of groundwater flow towards the Bay of Bengal. Instead, polluted water flowing in from all directions has been collecting in this depression.

Groundwater in some regions, naturally contaminated with arsenic, has been further contaminated by industrial pollution and domestic sewage. A 2002 study by the Central Ground Water Board (CGWB) found traces of toxic elements like chromium and cobalt in the shallow aquifers. The tanneries in east Kolkata are also culprits, discharging effluents into the wetlands and agricultural fields, which leach into the groundwater. In many places, the water is brackish and contains excessive amounts of iron, as in Jodhpur Park in south Kolkata or Salt Lake in the east.[20] A CPCB study done in 2004 (see Table: *Metal tinged*) found high levels of iron, manganese, cadmium and nickel in the samples.[21] Since the city lies in the arsenic belt of the country, in parts of Kolkata, particularly the southern parts, arsenic in groundwater exceeds the permissible limits.[22] All in all, the city has a toxic brew to drink.

TABLE: **METAL TINGED**

A 2004 CPCB study on groundwater quality looked at 25 samples and found high levels of metals like iron

Parameters	In pre-monsoon samples (in mg/l)	In post-monsoon samples (in mg/l)	Desirable limit (in mg/l)	Samples above the limit (in percentage of total)
Total hardness	203-995	179-1002	300	48
Total dissolved solids	614-1978	499-1939	500	100
Chloride	45-805	62-825	250	66
Iron	0.275-21.38	0.437-5.30	0.3	96
Alkalinity	200-552	148-436	200	100
Manganese	0.011-0.889	0.016-0.985	0.1	76
Cadmium	0.008-0.028	0.001-0.003	0.01	28
Zinc	0.213-12.2	0.210-9.17	5	20
Arsenic	0-3.7	0-0.065	0.05	36
Mercury	0.001-0.005	0-0.003	0.01	72

Source: Anon 2008, *Status of Groundwater Quality in India-Part II*, Groundwater quality series: GWQS/10/2007-2008, Central Pollution Control Board, New Delhi

DISTRIBUTION

How does Kolkata fare in distribution of water? KMC officials claim to cover 85 per cent of the population by piped supply; the Asian Development Bank's (ADB) *2007 Benchmarking and Data Book of Water Utilities in India* puts the figure at about 80 per cent. The water is supplied through a distribution network of 5,500 km of underground pipelines, supported by 13 pumping stations in the four zonal mains. Though there is no apparent dearth of water, the city lacks resources to treat the water or maintain and manage the distribution system – officially losing about 35 per cent of it.[23]

It is also clear that its claims of 'reaching' people are tenuous. To begin with, the distribution system has been falling apart as a large part of the network has long outlived its life. Tank leaks – major as well as minor – are endemic and bursting of pipes is frequent. Increased pressure of water often leads to buckling down of century-old pipelines, resulting in massive leakages. In 2006, the Palta treatment plant had to be shut down as the 22-km pipeline connecting the Tallah pumping station to the plant developed as many as 17 leakages – this meant a frequency of one leak for almost every kilometre of the pipeline.[24] The city claims that it does not lose all this water, it is also stolen. According to B K Maiti, the then officer on special duty, water department, KMC: "A recent World Bank study proclaims that as much as 35 per cent of the city's water is unaccounted for, being lost not only due to leakages from worn-out pipes, public taps and standposts, but also by illegal tapping."[25]

Then there are areas that have no pipelines at all. According to a report in *The Telegraph* in December 2008, water treated at the Palta and Garden Reach plants does not reach most homes in Kasba, Dhakuria, Behala and Tollygunge in south Kolkata. While residents have to queue for tubewell water, which is salty, about 274 MLD of treated water goes waste because of lack of pipelines.[26]

THE ECONOMICS

The KMC runs in losses. The reason is simple: the agency does not charge its customers for the water it supplies – only 10 per cent are billed for water services. Water for domestic consumption is not charged at all, and there are no individual water meters. The corporation only charges for bulk supply for domestic uses. Only 175 bulk connections are metered, of which 84 are domestic and 91 are industrial, commercial and institutional connections.[27] This, when the corporation has a very complicated water tariff system, varying between volumetric rates and flat quarterly rates based on unit hours or individual connections. For bulk users of water, the charge is volumetric, with both uniform and slab rates. But in total, recoveries remain notional (see Box: *Water tariffs in Kolkata*).

In this situation, the municipality cannot recoup even 20 per cent of the total costs it incurs (see Graph: *Mounting costs, little returns*). In 2005, Rs 140 crore was spent in the generation and supply of water, while only Rs 26 crore was recovered as charges. Each year, almost 30 per cent of total expenses go to energy bills and the rest are spent on staff salaries. The ratio of staff to connections in Kolkata is high; for every 1,000 connections, there are about 21 employees in the government water supply department.[28]

This 'red' balance sheet is when the city is blessed with the cheapest water costs – based on the quantum of water sourced and the annual expenditure – it costs only Rs 3.15 per kl to supply water in Kolkata.[29]

However, major changes in the city's water taxation regime have been in the air for some time, courtesy the financial clout of the Asian Development Bank (ADB), which has been footing the bill for sewage development. The city has made plans to increase water charges and also fix meters in homes (see Box: *Water taxed*). The Kolkata Environmental Improvement Project (KEIP) was asked to oversee this effort. In 2009, an order for 15,000 meters was placed with the KEIP, reported *The Statesman*. Three agencies – Severn Trent (UK), Veolia (France) and Jusco (Jamshedpur) – were short-listed for providing the meters.[30]

In January 2011, the West Bengal government allotted Rs 9 crore to purchase water meters for the Kolkata Municipal Corporation areas. To ensure the release of Rs 2,100 crore, the second instalment from ADB, this process has to be completed by March 2012.[31]

TABLE: WATER TARIFFS IN KOLKATA

The tariffs apply only to non-domestic connections

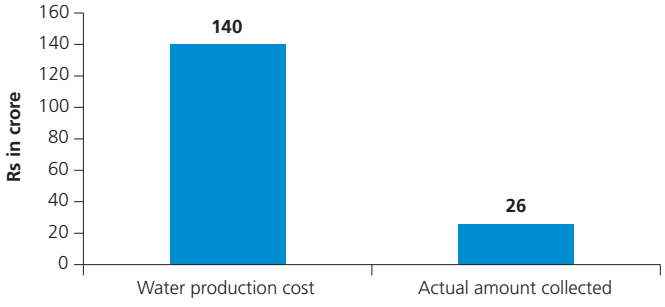
Ferrule size	Monthly rate (in Rs)	Ferrule size	Monthly rate (in Rs)
1/8"	200	½"	700
3/16"	250	Above ½"	1,100
¼"	300	¾"	1,800
3/8"	500	1"	2,700

Source: Anon 2008, *2007 Benchmarking and Data Book of Water Utilities in India,* Asian Development Bank, New Delhi

Note: No charge is adopted for ferrule sizes of ¼" to 3/8" for slum dwellers. For bulk supply to commercial establishments, the charge is Rs 10 per kilolitre.

GRAPH: MOUNTING COSTS, LITTLE RETURNS

The municipality recovers only 20 per cent of its costs



Source: Based on data received from Kolkata Municipal Corporation, 2005-06

WATER TAXED

Kolkata's residents will now have to pay for water

From May 2008, the Kolkata Municipal Corporation (KMC) started levying a water tax on its consumers, with the assurance that it would not be "heavy on the pocket". Known as 'water service charge', it was based on the ferrule size provided by the civic body.

The *Times of India* of February 17, 2008, which carried this report, also reported that the new tax structure was based on a model designed by city economist Jayasree Roy. "We conducted a broad household survey in all 141 wards and came up with the payment structure," said Roy, who teaches at Jadavpur University and has been researching the economics of water use since 2000.[1]

The tax structure was based on volumetric use. Roy's research found 65 LPCD was the subsistence-level need and recommended that this be supplied free of charge. The KMC decided that the first 1,000 litre used per day would be free for a family of five. For use amounting to 8,000-10,000 litre a day, Rs 10-12 was to be charged per thousand litre. The rate would be increased to Rs 25 per thousand litre if consumption was found to be in the range 12,000-17,000 litre a day. People below the poverty line, including slum dwellers, would be spared from paying the tax.

Initially, during the 'testing phase', the corporation would charge a flat rate of about Rs 150 a month, said Roy. A decision to install water meters in high-rises and group housing societies was also taken. Residents would have to register their names for water meters with KMC. It would then install about 100,000 water meters, obtained from the Asian Development Bank, in homes on a first-come-first-served basis. Those who failed to register at the camps set up for the purpose would have to continue paying the flat rate tax, which was slated to increase by 20 per cent every year.[2]

SEWAGE

GENERATION AND COLLECTION

All estimations of Kolkata's sewage generation are, necessarily, off the mark – as the city has no idea how much groundwater is extracted from private sources, and hence, how much wastewater is generated from it. Geography also determines its sewage disposal. The city is situated in one of the world's largest deltaic regions, about 8 m over the mean sea level. The drainage slopes to the sea, in the east of Kolkata. But over the years, unplanned growth and construction over its drainage outlets and wetlands has left the city exposed to floods and sewage backflows.

The city's colonial rulers built its first engineered sewage system in the late 1800s. The plan was drawn up for a small city, which discharged its waste into the Bidyadhari river – a tidal creek east of the city. But soon, the river started silting up. In 1934, a new plan, credited to city engineer B N Dey, was conceived and completed in 1943. This involved the construction of channels to carry dry weather flows and stormwater flows to river Kulti Gong, which in turn drained into the Bay of Bengal. The city thus, has twin river systems – Hooghly to bring it water and Kulti to take away its waste.

It was in this period as well that the city got its most important waste engineering plant – a pisciculture system, which would use the waste of the city brought by the channels to culture fish and grow vegetables. The system was developed in the wetlands of east Kolkata and continues to be the city's saviour treating almost a third of its sewage till date (see Section: *East Kolkata Wetlands*).

Even today, the city drains the bulk – over 75 per cent – of its rainwater and sewage through channels into the Kulti. These are the channels which flow though the wetlands of east Kolkata. The remaining 15 per cent drains out mostly in the northern region via the Circular Canal system; a small portion flows out through drains in the south and into Tolly's *Nullah*. According to the 2006 ADB report prepared for a supplementary loan to the Kolkata Environmental Improvement Project (KEIP), 50 per cent of the city's population on its eastern side is connected to sewerage drains, which drain out to the rivers and channels (see Box: *The Environmental Improvement Project*). The rest finds it way through the 2,000 km of open drains into the ground or through various channels to the surrounding rivers. More importantly, only 17 per cent of the outer areas, comprising the metropolitan region, have any sewage connection.[32]

The city's closed drainage system is also notional. The brick-layered sewers covering some 180 km and piped sewerage of another 1,400 km are in serious trouble. The system is heavily clogged; manholes are choked and sewers are blocked at many points with garbage. The combined underground sewerage system, which discharges both rain and dry weather flow, is at the verge of a near total collapse. It cannot handle rainfall intensities crossing the 6 mm per hour mark, as a result of which large areas remain under water during monsoons.[33]

Worse, the city has now resorted to encroaching on and filling up its inland water bodies to construct buildings. This practice has not only reduced availability of water resources to a great extent, but has also increased stormwater run-off and stagnation of water. These waterbodies are also being used as waste dumps. In the newly developed colonies to the east, supply is mainly from groundwater and the untreated sewage is being dumped into open streams and canals.

TREATMENT AND DISPOSAL

Kolkata has no sewage treatment plants (STPs) within its municipal area. The city's three plants are located outside its municipal limits at Bangur, Garden Reach and Bagha Jatin (small plant of 2 MLD capacity) (see Table: *Kolkata's STPs*).[34] It is well accepted that the plants, even though they exist on ground, do not do much to treat the sewage.

The 45-MLD Bangur STP receives just about 30 hours of wastewater and is caught in a struggle for control between agencies. The KMC wants to take over the plant. It has already taken charge of three pumping stations. But the main pumping station and the sewage plant itself are still in control of the Kolkata Metropolitan Development Authority. The complication does not end there. While the sewage comes from the area

THE KOLKATA ENVIRONMENTAL IMPROVEMENT PROJECT

Massive effort at upgrading the city's sewerage and drainage plagued with delays

On July 24, 2002, the Government of India and the Asian Development Bank (ADB) signed a loan agreement on the Kolkata Environmental Improvement Project (KEIP or CEIP). The main objectives of the project include the creation of a policy and institutional framework to sustain investments in sewerage and drainage, solid waste management, slum improvement and canal rehabilitation. Supposed to have been completed by June 2007, delays arising out of cost escalations shifted the estimated date of completion to June 2010.[1] The implementing agencies for the project are the KMC and the Irrigation and Waterways Department of the state government.

According to newspaper reports, the work to be carried out under the project includes sewerage and drainage for more than two million people, solid waste management for five million, enhanced urban services for 200,000 slum dwellers, and flood protection. The scope of the project has undergone several changes since 2000, with the inclusion of a new borough, a rise in the number of affected persons to be resettled, higher compensation, and changes in canal improvement works.

In addition, costs of goods and services have risen significantly. Revised costs for the project are now more than Rs 1,800 crore, of which the Bank is advancing Rs 1,160 crore (including the supplementary loan). The West Bengal government and the KMC will cover the rest of the cost. The loan is spread over 19 years. The question that has gone unanswered is how the KMC will pay for the loan it has taken when it cannot even recover its current costs, when it spends little and earns even less. But that is clearly a question less asked and certainly not answered.[2]

Besides, the KEIP has a history of ill-planning. The Rajapur Canal in Kolkata, cleaned in June 2008 under the project, returned to its old state within six months, plastics, debris and weeds choking it once again. When the municipality dredged the muck from the canal, it dumped the debris on the canal's sides. The rains came, and all the dug-out filth was drained back into the canal!

TABLE: **KOLKATA'S STPS**

The plants treat only 15 per cent of the city's sewage

Name of the STP	Capacity (in MLD)	Technology adopted	Treated sewage disposal
Garden Reach	79	Activated sludge process	Hooghly river
South Suburban East	30	Waste stabilisation pond	Hooghly river
Bangur	64	Activated sludge process	Hooghly river

Source: Anon 2006, *Status of Sewage Treatment Plants in India*, Central Pollution Control Board, New Delhi

controlled by the KMC, the plant is located in an area which is under the control of its neighbouring municipality – South Dum Dum. Now, under the ADB-funded KEIP, the KMC wants to build a direct pipeline connecting its households to the STP, hoping to bypass all the municipalities and agencies in its way.[35]

Similarly, the Garden Reach STP, built at a cost of Rs 28 crore under the Ganga Action Plan in the 1990s, still remains largely unconnected to the sewage it has to treat. The plant is now under the KMC, which intends to upgrade it from 47.5 to 52 MLD. The sewage is intercepted from various canals and after treatment, flows into the Hooghly, though the Monikhali Canal.[36]

THE EAST KOLKATA WETLANDS

Interestingly, even without sewage treatment plants, this big city with its big waste footprint has not lacked treatment of sewage. This is because it diverts a large part of its sewage – about 60-70 per cent – to the wetlands in the east, which have sustained one of the largest examples of an integrated resource management system for the past 60 odd years. The East Kolkata Wetlands, a series of ponds and marshes created by the shifting of the river Hooghly, can receive and effectively treat some 810 MLD of city sewage every day.[37]

The sewage acts as the nutrient for the fish and farms of the wetlands. At the same time, the wetlands purify the water through oxidation and natural aeration in fish ponds and channels which range over some 2,000 km. The sewage flows in a series of ponds where the sludge settles down, and oxidation happens as the sewage is exposed to sunlight.[38]

The system functions in this way: a network of channels – locally called *khals* – conveys the sewage to the fish *bheris* (ponds). These *khals* are segregated as primary, secondary and tertiary channels, based on their functional features. The regulator gate holds the key to the supply of sewage to the entire area. The shallow depth of the fisheries (only a metre) makes it easy for sunlight to penetrate the bottom. This naturally cleanses the system by reducing the coliform (*E Coli)* and biochemical oxygen demand (BOD) levels and increasing the dissolved oxygen (DO) levels in the wastewater. The fish ponds act as solar reactors. In this system, BOD levels have been known to have come down from 150 mg/litre to as low as 30-40 mg/litre.[39]

From the sewage-fed *bheris,* the water flows into garbage farms and rice fields. At present, over 3,898 hectare (ha) of wetlands (of this, about 697 ha are seasonal) are covered with about 58 sewage-fed fisheries, providing direct employment to 15,700 people and indirect employment to another 23,600. The yield rate is amongst the best in any freshwater pisciculture practised in the country, and the area has the largest number of sewage-fed fish ponds in the world located in one place. It is estimated that these *bheris* produce 8,000 tonne of fish annually; the farms produce 150 tonne of fresh vegetables daily; and the rice fields, 160,000 tonne annually.[40]

In this way, roughly a third to half of the city waste is treated and disposed off. After this natural treatment, the effluent flows into the wastewater receptacle of Kolkata, the Kulti Gong, a tidal stream of the Bay of Bengal located near Ghusighata some 28 km towards the east of the city.[41]

PRADIP SAHA / CSE

The bheris *grow vegetables and spawn fish. At the same time, the sewage water is purified through oxidation and natural aeration*

IMPACTS

FLOODS

For this city located almost at sea-level and in a tropical high rainfall region, drainage is its lifeline. When it rains, it pours. The city has to flush out the water into its rivers, channels or store it in its wetlands and tanks. The city has enough water to drink. What it needs is ways in which it can dispose off its waste. This is why in Kolkata, its wetlands provide the city with its most crucial buffer. They are the sponges for its waste and water. More importantly, they give it natural and cheap waste treatment options. No energy is needed to pump and to treat the waste; no chemicals are required either, and no expenditure on staff to operate the sewage treatment plants. Instead plants, solar energy and fish do the cleaning trick.

But in its haste to grow, without planning and thought, the city is fast losing this natural flush and sponge. Now every time it rains in Kolkata, it not only pours but it also floods. The city is drowned with every monsoon rain. In September 2006, when the city once again went under water, Dhrubajyoti Ghosh and a group of scientists issued a statement on waterlogging and floods in the region. They wanted planners to understand the role of wetlands and natural drainage systems in this naturally sloping city. But the building boom is taking over as never before (see Box: *Encroached wetlands*). Two cases filed in the High Court to protect the wetlands became iconic – the Rabindra Sarobar Lake case (see Box: *Saving a lake*) and the East Kolkata Wetlands case. But these are losing battles in a situation where planners and builders only see land and not water.

THE FIGHT TO SAVE THE WETLANDS

In 2002, after a sustained fight by environmentalists, the wetlands, the 'kidneys' of the city, were designated as a Ramsar site: they were declared a wetland of international importance under the global Ramsar Convention. But this did not come without a fight. It was in 1992 that a citizen's group, People United for Better Living in Calcutta (PUBLIC), filed a case in the High Court against the change in land use of the wetlands.

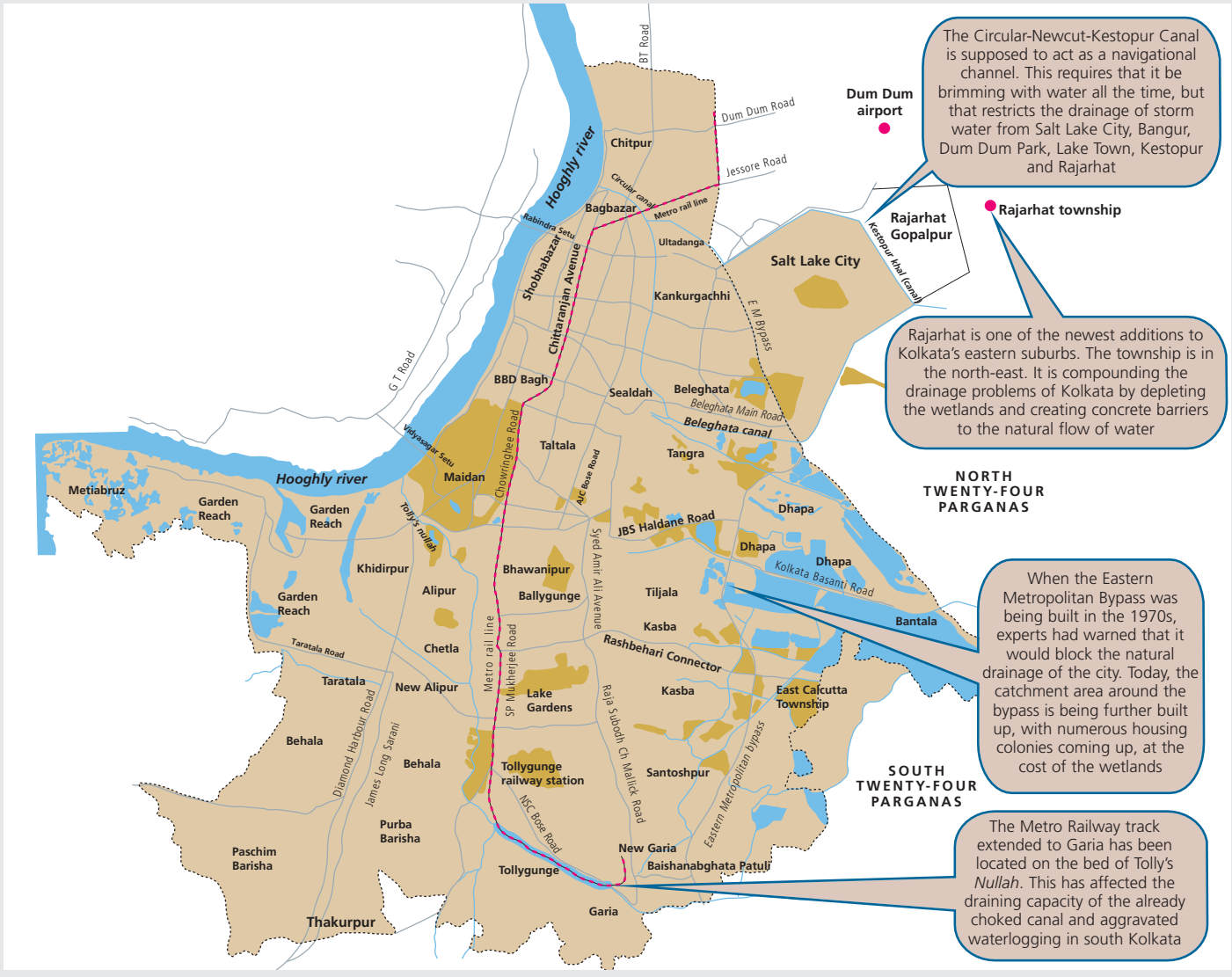
In 2005, the court came down heavily against the builders. It asked for the wetlands to be protected and directed the government to pull down illegal constructions, including two high profile housing estates, in the wetlands. The area was declared a no-development zone. In 2005, the East Calcutta Wetlands Conservation and Management Act was legislated, which also set up the East Kolkata Wetland Management Authority with the state chief secretary as its chairperson. The Act allowed the government to demarcate the boundary of the wetland and to take steps to stop and to demolish any unauthorised development project or illegal use of the wetlands. Using the legislation, the government incorporated more area as protected under the wetland legislation – taking it to 12,571 ha. However, it did not ask for some 50,000 villagers living in about 32 *mouzas* (settlements) to be relocated.

ENCROACHED WETLANDS

The damaged and silted canals lead to flooding

Kolkata went under water on September 24, 2006. The Meteorological Office said that Kolkata received 211.6 mm of rain on September 22. That was 168.4 mm less than what fell on September 27, 1978, yet the water did not recede for 10 days in many areas. Salt Lake, the eastern township, was not spared. This is because the city's drainage system was in shambles. The expanding city has been overrunning its eastern wetlands, the natural draining ground for the easterly sloping city.

- Kolkata is 20 feet above mean sea level. Draining is difficult, even when rain is modest: the task becomes monstrously difficult whenever intense precipitation and the high tide in the Hooghly coincide, as they did in late September.
- The city started expanding eastwards after the 1930s. The boom continues. Buildings are taking over wetlands.
- Kolkata's old *khal* or canal system, which acted as an effective drainage system for some three centuries, is in disrepair. Many wastewater conduits out of the city such as storm water drains, sewers and canals are silted. Besides, gully pits are blocked and there is a time lag for water to reach the pumping stations. This leads to flooding on the surface. Poor solid waste management, along with an overburden of plastic, is the culprit.
- The original design of Kolkata's drainage system was based on the drainage capacity of the sub-basins. But the unplanned diversion of surface run-off from one sub-basin to another is one of the reason for overloading of the existing drains, resulting in flash floods.
- In the metropolitan part of the city, the demise of small water bodies has created problems in holding capacity of surface run-off and groundwater recharge. The filling up of ponds and marshlands to obtain real estate is linked to increased problems of drainage and flooding.



Source: Anon 2006, 'Venice unintended', *Down To Earth,* Vol 15, No 11, October 31, Society for Environmental Communications, New Delhi

SAVING A LAKE

Public and judicial action in cleaning Rabindra Sarobar

Rabindra Sarobar Lake, previously known as Dhakuria Lake, is an artificial waterbody in south Kolkata. The lake is spread over 48 hectare and comprises several smaller waterbodies. It was dug in the 1920s to provide soil for filling up the low-lying areas of Ballygunge, at that time being made habitable by the Calcutta Improvement Trust.

In 1997, Subhash Dutta, representing the Howrah Ganatantrik Nagarik Samiti (HGNS), along with two other non-governmental organisations Rabindra Sarovar Bachao Committee and Paribesh Dushan Rodh Committee, filed a petition in the green bench of Calcutta High Court demanding development of the lake. In 1999, the green bench ordered that a Rs 76-crore project be executed to build sanitation facilities for slum-dwellers. As per the order the cost of installing these facilities was to be shared by the Eastern Railways and the state government. Eastern Railways (ER) demanded eviction of settlers but the state favoured improvement of their conditions. The ER moved the Supreme Court against the state's decision, and the apex court asked the state government to evict the 'squatters'. In 2003, civil society moved the apex court against the eviction directive. Once again, the Supreme Court rejected the petition and ordered eviction.

In 2003 the lake was listed under the National Lake Conservation Scheme and Rs 4 crore was sanctioned for its 'beautification'. And in 2005, petitioner Dutta announced that he would not proceed with the litigation as his aim of a pollution-free lake had been achieved. By 2006, the state government submitted a compliance report in the court saying that the encroached area had been cleared. The railway authorities also informed the court that they had got possession of the land and had started building a boundary wall. Satisfied with the reports, the division bench of the High Court disposed off the case.[1]

But the struggle to protect the wetlands continues. In 2006, PUBLIC went to court again alleging that the corporation had selected Bointala in Dhapa for its new water supply project, though the area was a protected wetland. In 2008, the High Court decided in favour of the project. But it imposed strict conditions, including specifying the quality and nature of the materials that could be used in the water supply project. It also appointed a three-member committee – which included two former university vice-chancellors and a professor – to monitor compliance.

When another government project, this time to build a bus terminal in the green lung of the city in Esplanade, was shot down by the High Court, the agency decided to move it to the wetlands. Then in 2006, the government came up with another plan – to build a 85-km four-lane highway called the East Link Highway. However, environmentalists feared that this would cut through the wetlands and protested vociferously. Authorities argued otherwise, saying that the environmental impact assessment would take care of everything. The fight continues (see Box: *A wedge through the wetlands*).

The state government, however, has tried to take some action which regard to the wetlands. To check building activities in the wetlands, the government in 2008 ordered that local authorities – municipal corporations, *panchayats* etc – have to take clearance from the East Kolkata Wetland Management Authority before issuing licenses to build and sanctioning building plans. In addition, it directed the land department not to issue permissions for change in land use without the clearance of the authority. This is when it found that plots were being sold in the wetlands and building rules were being flouted rampantly. But monitoring implementation in the populated wetland is difficult.[42] Now the government is working on plans to turn the wetlands into a park – with conservation and tourism facilities. It wants its own wastewater 'kidney' to be developed like the wetland in Hong Kong.

But civic groups are clear: their fight to save the city's wetlands is far from over.

A WEDGE THROUGH THE WETLANDS

A proposed road is planning to drive one

In 2006, West Bengal signed a much-hyped deal with the Salim Group of Indonesia for investments of up to Rs 20,000 crore in infrastructure development. Billed as the 'New Kolkata International Development Project', the deal included expressways, bridges, special economic zones, industrial hubs and health and knowledge cities. But one of the deal's components – a proposed 85-km, four-lane expressway from Barasat in North 24-Parganas district, to Raichak in South 24-Parganas – had Kolkata environmentalists worried. Government officials said the actual route of the highway hadn't been mapped yet, but ecologists familiar with the geography of the area say it's unlikely such a road can be built without cutting through the East Kolkata Wetlands, a protected Ramsar site, and disrupting its fragile ecosystem.

"If the road indeed goes through the wetlands as we are suspecting, then God alone can save the wetlands," said Dhrubajyoti Ghosh, former chief environment officer of the state who in 2002 was instrumental in getting 12,500 hectare of the wetland area listed as an internationally protected site. Ghosh was also joint director of the state planning board in 1985 when the wetlands area was mapped.

Ghosh estimates the wetlands save the city about Rs 400 crore in capital expenditure and recurring maintenance cost on water treatment plants. Agriculture and aquaculture in the wetlands also provide significant income for sustaining livelihoods of thousands of families in the area. According to a study by Kolkata-based economist Gautam Gupta, the wetlands generate a value of over Rs 92 crore per year and provide income (Rs 2,000-Rs 3,000 per household per month) to sustain livelihoods of the poor residing in the wetlands. Apart from this, the wetlands are also home to a large biodiversity.[1]

SURFACE WATER: IN TROUBLE

The Hooghly river also gets its share of pollution of the city and its surrounding urban conglomerations. "Presently, a small amount of sewage (roughly 10 per cent) from the KMC area flows out untreated through a number of unauthorised channels and the Tolly's *Nullah* into the Hooghly," says S Bhattacharya, chief engineer of the Ganga Action Plan, Kolkata.[43] But this calculation does not account for the untreated and unconnected sewage from the urban region of the metropolitan area.

The Ganga Action Plan, launched in late 1980s, had targeted pollution to the river from the urban and industrial areas around Kolkata. A number of STPs were sanctioned and commissioned in the first phase of the Plan.

However, it was the tanneries of Kolkata which became the focus of river cleaning by pure accident in the 1990s. The tanneries were linked to a case in the Supreme Court being fought to clean the tanneries of Kanpur in Uttar Pradesh. The case, filed by lawyer M C Mehta, was enlarged to include all industries located on the banks of the Ganga to stop the discharge of untreated effluents into it. At this time, in 1995, the Nagpur-based National Environmental Engineering Research Institute (NEERI) had analysed samples and found chromium in the water. The case gathered steam, and a judgement was passed on December 19, 1996; the tanneries were asked to relocate. It was hoped that pollution would go away. But as with all such schemes, planning was poor and the relocated tanneries, instead of reining in the pollution, have probably added to the problem in the delta (see Box: *Relocating tanneries: good or bad?*).

But according to the West Bengal Pollution Control Board (WBPCB), there is no pollution problem in the vicinity of Kolkata. Monitoring is done for physico-chemical and bacteriological parameters during both high and low tides. The board also regularly monitors the water quality of the city sewage canal near the Calcutta Leather Complex and at Ghusighata. The monitoring results have found BOD levels to be below the maximum permissible limit of 3 mg/l; DO levels have been found to be higher than the prescribed standard of 4 mg/l – this indicates that the quality of river water does not threaten the survival of aquatic life.[44] But as far as bacteriological parameters (total coliform and faecal coliform counts) are concerned, the river waters have been found to be unfit for human consumption or use.

The city also has a number of big ponds – but most of these have turned into cesspools, teeming with sewage and garbage. About 3,000 odd waterbodies remain, serving the needs of 400,000 people and catering to 15 per cent of the city's water requirements.[45] While no study has been done till date on the management issues of these urban and peri-urban waterbodies, it is a fact that many of them have been encroached upon and filled over due to lack of planning, information and management.

SEURECA, SEURECA!

Findings of a study: faults in city water and sewage management of posh Salt Lake

The posh residential neighbourhood of Salt Lake is considered the ideal of town planning. However, a 2007 study conducted by French consultants Seureca, under appointment by the Bidhannagar municipality, pointed out serious faults in water supply, drainage, sewage system and solid waste management of Salt Lake.

According to a report in February 2007 in the *Kolkata Newsline*, the worst of these is a seriously faulty sewage system: the findings of the Seureca study confirm the poor performance of 277 km of pipes that constitute the system. The study has pointed out that lack of cleaning of the sewage primary collectors leads to frequent blockages, and that the pumping equipments in sewage stations are ill-maintained.

Moreover, due to the clubbing together of the drainage and sewage systems, the Keshtopur Canal, which should have been receiving only drainage water (consisting of rainwater, water from gardens and other surface run-off) as per the original plan, was now getting contaminated by sewage flows. The water from the canal would have supported the new town of Rajarhat, but obviously could not do so in such a state.

Salt Lake has one sewage treatment plant: the Bagjola STP. The plant is ill-equipped to handle the entire sewage from the area, and has not had a major overhauling in more than three decades. It does not have a 'secondary clarifier', a vital unit in the water treatment process, and its 'bio-filter' has not been functioning for almost two decades.[1]

LOOKING AHEAD

Kolkata is a city, triple-blessed. It has a river for its water, another river where it can discharge its waste, and wetlands which can clean its sewage and produce its food. Its cycle of water and waste is a closed cycle – water to water; water to food. But unfortunately, the city is close to losing this water wealth. Its policy makers, egged on by a vigilant civil society and ecologists, have done well to protect its wetlands – its kidneys. This flush is unique and provides a model of biological treatment of sewage at affordable rates for many other cities.

Now the city's second generation reforms must begin.

The key is to understand the geography of the city, which is located at almost-sea level. The city's challenge is, firstly, to ensure drainage of its water and to take measures so that the stormwater does not get mixed with its sewage water. This requires it to protect its wetlands and lakes, even more than before. These are the sponges of the city as well as its kidneys. Secondly, in all this, instead of building capital-intensive STPs, which will require money for electricity to pump the sewage and to treat the waste, the city will do well to improve the effectiveness of its biological treatment zone through new innovations to provide oxidation of water and more flow.

Thirdly, the city should segregate its waste – sort out the domestic from the industrial and chemical discharges. This is because the wetlands can treat the biological contamination effectively, but will fail to get rid of its chemical and heavy metal

RELOCATING TANNERIES: GOOD OR BAD?

Kolkata tanners question the efficacy of moving to a new location

Were the tanneries of Kolkata polluting the Ganga? The government thought so. The Supreme Court, hearing the case on the pollution of the Ganga filed by environmental lawyer M C Mehta, thought so as well, and asked for such units to be shifted. The tannery owners challenged the order. They said that the site where they were to be relocated was, in fact, part of the wetland area of the city and the tannery waste would be discharged into the same channel that carried the city waste. Their plea went unheard, and the government began the process of relocation.

Between 1997 and 2003, the state government acquired a 445-hectare (ha) plot at a cost of Rs 18 crore, with an indicative project cost of Rs 158 crore to develop the infrastructure. It hired M L Dalmiya and Co Ltd as a partner on a build-operate-transfer basis for 30 years. Dalmiya was made responsible for setting up on-site infrastructure such as roads, lighting, water supply system, and the common effluent treatment plant (CETP). All this cost the company approximately Rs 291 crore to develop. The state government spent Rs 31 crore to develop off-site infrastructure such as widening of the highway, excavation of outlet channel, setting up of an 80-MW power station, among other facilities.

Of the 445 ha acquired, 225 ha was earmarked as saleable by the company to pay for the development work. The 135 ha that was allocated to tanneries was reduced, citing shortage of water as reason. Reduced allotment of water was cited as the reason for low supply. But this 'reduction' gave Dalmiya a bonanza. The remaining land was allocated to an information technology (IT) park; the argument being that this industry was not water-intensive. Eventually, however, the 53 ha which was to be sold to the tanners at Rs 600 per sq m, fetched Dalmiya rates above Rs 3,000 per sq m.

Treatment blues

The deal was to build a CETP to treat the waste before discharge. The project, initially allocated Rs 65 crore under GAP-II for six modules of 5 MLD each, was to be shared equally by the Central and state governments. But the project cost was revised to a whopping Rs 135.44 crore and now the question was, who would finance it and how? This was when it had also been agreed that the tannery association would pay back the capital cost in quarterly payments over 10 years after a three-year moratorium.

In 2006, the tannery association complained that Dalmiya had failed to construct the common effluent treatment plant, as promised. Officials in the Directorate of Industries say Dalmiya was reluctant to construct the treatment plant because of doubts over the tannery association's willingness to pay back the capital cost. Dalmiya wanted a guarantee from the state government. In all this mess, finally, the state government set up the first four plants of 5 MLD each at a cost of Rs 61 crore.

Now arose the tricky question of payment for treatment. The tannery association alleged that Dalmiya billed them at Rs 42 per kilolitre (kl) of effluent. So the association formed a company in October 2004 and approached the state government to take over the management. This was agreed upon, and it now runs the plant and charges Rs 14 per kl.

"Capacity is not an issue. With an increase in number of functioning units, the plant receives 14-15 MLD of the 20-MLD installed capacity," says Tapash Gupta, a scientist with the West Bengal State Pollution Control Board. Performance of the plant, however, at times was found to be below par. Data for February-April 2007 from the tannery association shows that total suspended solids ranged from 71-228 mg/l (norm: 100 mg/l); biochemical oxygen demand at 70-170 mg/l (norm: 100 mg/l); and sulphide levels touched a maximum of 2.8 mg/l (norm: 1 mg/l). Chromium levels for all samples were within norms. "Other heavy metal parameters are not monitored," said Qammrul Hassan, manager at the Kolkata Leather Complex Tannery Association. "This is the first common effluent treatment plant in the state. Its performance will improve with time," Gupta assured.

The remaining effluent was given extended aeration before it was passed through the final outlet, a 1.5-km pipeline which flows to the combined channel located opposite the complex, which drains 75 per cent of Kolkata municipality's stormwater and dry weather flow. But this outlet was choked and, therefore, an open drain was constructed to dispose off the treated effluents. The annoyed tanners said that inadequacy of the channel at times resulted in backflow.

The combined channel, which receives the treated effluents, drains into the same channel which carries the city's waste through the wetlands into the Kulti river. Waste into waste. But with a difference: this time, the chemical waste, though treated, is mixed into what is a biological treatment zone. Only time and a lot more monitoring will show if this indeed is the best solution.

waste. This must be its plan.

Fourthly, and most crucially, the city will have to improve its distribution of water and the systems to take back the waste. The city wants to do this thoughtlessly. It believes it has funds from the ADB and this will buy it its water future. But nothing can be further from reality. The fact is that Kolkata has low (perhaps the lowest in all metros) cost of water delivery. It also has poor people, who cannot afford much more. It needs to ensure that the systems of the future build on this strength. Today, it is not delivering to all. Even where it delivers, people dig deep into the ground and abstract more and more. The city must reform this. It must ask the rich and water-using population to pay, it must insist on recharge of its groundwater systems – it has enough rain – and it must build on the strength of its local tanks and lakes, which allowed it to recharge every monsoon.

All in all, the city has the opportunity to showcase a different water-waste future. But this will require it to think differently and to dream differently. It cannot be the New York of India. But it certainly can be the Kolkata of midnight dreams, if it gets this equation right.